# TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No. 89190.157900

In Re Application Of: **Bircann, et al.**

| Application No. | Filing Date | Examiner | Customer No. | Group Art Unit | Confirmation No. |
|---|---|---|---|---|---|
| 09/777,471 | 02/6/2001 | D. Bondere | 23469 | 3732 | 4278 |

Invention: **SLEEVELESS SOLENOID FOR A LINEAR ACTUATOR**

COMMISSIONER FOR PATENTS:

Transmitted herewith in ~~triplicate~~ is the Appeal Brief in this application, with respect to the Notice of Appeal filed on **September 10, 2004**

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*Signature*

Dated: **November 10, 2004**

**Dennis B. Danella, Esq.**
**Reg. No.: 46,653**
**JAECKLE FLEISCHMANN & MUGEL, LLP**
**190 Linden Oaks**
**Rochester, New York 14625-2812**
**Telephone: (585) 899-2930**
**Facsimile: (585) 899-2931**

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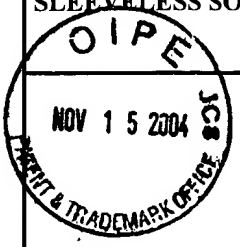
|---|---|---|---|---|
| Application No.<br>**09/777,471** | Filing Date<br>**02/06/2001** | Examiner<br>**D. Bonder** | Customer No.<br>**23469** | Group Art Unit<br>**3732** |

Invention:

**SLEEVELESS SOLENOID FOR A LINEAR ACTUATOR**

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P07A/REV04

**IN THE UNITED STATES PATENT & TRADEMARK OFFICE**
**BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

| | | |
|---|---|---|
| Applicant(s): | Bircann et al. | Examiner: D. Bonderer |
| Serial No.: | 09/777,471 | Art Unit: 3732 |
| Filed: | February 6, 2001 | |
| For: | SLEEVELESS SOLENOID FOR A LINEAR ACTUATOR | |

## APPEAL BRIEF UNDER 37 C.F.R. § 41.37

**Mail Stop Appeal Brief - Patents**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This is an appeal from the final rejection of the Examiner dated May 7, 2004 rejecting claims 3-7 and 10-16.

The Commissioner is hereby authorized to charge the fee of $340.00 required under 37 C.F.R. § 41.20(b)(2), and any other fee which may be due, or credit any overpayment, to Deposit Account No. 10-0223. Further, if necessary, please consider this submission as a petition for an extension of time and charge any necessary fees that may be due to the Deposit Account listed above.

**IN THE UNITED STATES PATENT & TRADEMARK OFFICE**
**BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

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## I. REAL PARTY IN INTEREST

The subject application is owned by Delphi Technologies, Inc. of P.O. Box 5052, Troy, Michigan 48007-5052.

## II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences which would have any bearing on the Board's decision in the pending appeal.

## III. STATUS OF CLAIMS

Claims 3-7 and 10-16 have been rejected and are subject to this appeal; and

Claims 1, 2, 8 and 9 were cancelled from the patent application.

## IV. STATUS OF AMENDMENTS

In response to the Final Office Action dated May 7, 2004, Appellants submitted an Amendment and Response dated July 7, 2004 where claims 1 and 8 were cancelled and claims 3-7, 10-13 and 16 were amended. The amendment to the claims was entered by the Examiner for purposes of the present Appeal. *See Advisory Action* dated August 5, 2004.

## V. SUMMARY OF CLAIMED SUBJECT MATTER

In general, an improved sleeveless solenoid actuator in accordance with the invention is shown in FIG. 2 and comprises several elements analogous to elements in the prior art actuator (10) shown in FIG. 1. *See Specification*, pg. 4, lines 20-22. For instance, the improved solenoid actuator includes the housing (12), the first and second polepieces (14, 16), and the windings (18) from the prior art actuator (10), but the sleeve (32) is omitted. *See id.* at pg. 4, line 22; pg. 5, line 1. The air gap (36) is shown substantially larger than to scale for illustration purposes; preferably, the distance between the first polepiece (14) and the armature (20') is on the order of a small fraction of a millimeter. *See id.* at pg. 5, lines 1-3. A shaft (22') is press-fit into the armature (20') and may be provided with an annular flange (38) to spread the working load of the shaft against the armature (20'). *See id.* at lines 3-5. An axial bore (24') in the second polepiece (16), alternative to the bore (24) in the prior art actuator, retains a sleeve bearing (40) for radially supporting the shaft (22') in axial motion. *See id.* at lines 5-7. As already described, the shaft (22') is preferably fitted to the bore in the bearing (40) as closely as possible without engendering drag on the shaft. *See id.* at lines 7-8. The bearing (40) is coated with a permanent dry lubricant such as a fluorocarbon polymer and is formed of a commercially-available coated metal element. *See id.* at lines 9-10.

The axial length of the bearing (40) is at least 1.5 times the diameter of the shaft (22') to minimize wobble of the shaft in the bearing and resulting cocking of the armature in the polepieces. *See id.* at lines 13-15. To accommodate the

small tolerances necessary between the shaft and bearing, preferably the armature is tapered slightly to be frusto-conical having a cone angle substantially equal and opposite to the cone angle describable by the excursion limit of the shaft in the bearing, to provide the absolute minimum thickness of air gap while positively precluding the armature from striking the polepieces. *See id.* at lines 15-20. Thus, the air gap (36) is slightly thinner at the lower end (42) of the armature (20') and slightly thicker at the upper end (44). *See id.* at lines 20-21. Because the air gap is substantially fixed in size and shape and the armature cannot strike the polepieces, solenoid actuators in accordance with the invention may be used freely without regard to spatial orientation. *See id.* at lines 21-22; pg. 6, line 1. This feature can be extremely useful, for example, in fitting an EGR valve into the engine compartment of a vehicle. *See id.* at pg. 6, lines 2-3.

Referring to FIG. 3, the force advantage of removing the sleeve and narrowing the air gap in a solenoid actuator is clearly seen, the upper performance curve (46) representing the improved actuator (34) and the lower curve (48) representing the prior art actuator (10). *See id.* at lines 4-7. An improvement of about 20% is found over most of the range of armature travel, and 68% at the start of armature travel. *See id.* at lines 7-8. The latter is highly significant because this is the force available to, for example, begin opening a valve, at the time when the greatest pressure difference exists across the valve (greatest resistance to opening). *See id.* at lines 8-10. Thus, a solenoid actuator in accordance with the invention might be made about 20% smaller and lighter than a prior art actuator for a given application. *See id.* at lines 11-12.

Referring to FIG. 4, a second embodiment (50) of a solenoid actuator in accordance with the invention is shown mounted via standoffs (51) onto an EGR valve (52) to form an EGR valve assembly (53) which is bolted to the exhaust manifold (54) and the intake manifold (56) of an internal combustion engine. *See id.* at lines 13-16. Embodiment (50) has a spool bearing (40') instead of the sleeve bearing (40). *See id.* at lines 16-17. The shaft (22') engages the outer end (58) of the pintle (60) of the valve (52) to open and close the valve head (62) from the valve seat (64) to selectively admit exhaust gases from the exhaust manifold (54) into the intake manifold (56) to reduce smog emitted by the engine (70). *See id.* at lines 17-20.

## VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 3 and 4 stand rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,313,726 to Golovatai-Schmidt et al. ("the Golovatai reference").

Claim 5 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the Golovatai reference.

Claims 6, 7 and 10-16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the Golovatai reference in view of U.S. Patent No. 5,947,092 to Hussy et al.

## VII. ARGUMENT

**Issue 1 – Whether claims 3 and 4 are anticipated under 35 U.S.C. § 102(a) by U.S. Patent No. 6,313,726 to Golovatai et al.**

Independent claim 3 is directed to a solenoid for providing linear actuation. The solenoid includes first and second polepieces having axial bores coaxially disposed along a common axis, an electrical conductor wound about the polepieces in a plurality of turns, an armature, a bearing and a shaft. The armature is frusto-conical and movably disposed in the axial bores. The frusto-conical section of the armature is adjacent to a substantial portion of the first and second polepieces. The bearing is axially retained in one of the first and second polepieces. The shaft is attached coaxially to the armature and extends through a supportive bore in the bearing wherein the bearing radially supports the shaft. The shaft is axially displaceable by electromagnetic displacement of the armature to provide the actuation. The armature is entirely separated from the axial bores of the polepieces by a generally cylindrical air gap, wherein the armature is prevented from contacting the polepieces.

Appellants submit that the Golovatai reference does not teach or suggest a solenoid having an armature that is frusto-conical, wherein the frusto-conical section is adjacent to a substantial portion of the first and second polepieces as recited in claim 3. In the Final Office Action, the Examiner stated that the Golovatai reference discloses a valve including an armature (110) that is frusto-conical. *See Final Office Action* dated May 7, 2004, ¶ 2, bullet points 6 and 10. Upon review of the Golovatai reference, Appellants cannot find an armature

labeled with reference numeral (110). Therefore, for purposes of this issue, Appellants will assume that the Examiner is using the armature labeled with reference numeral (8) in the Golovatai reference to disclose the frusto-conical feature in claim 3.

The term frusto-conical is defined as the shape of a frustum of a cone, wherein the frustum is the part of a cone-shaped solid next to the base and formed by cutting off the top be a plane parallel to the base. *See* WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 917 (1993) (stating definitions for frusto-conical and frustum). As best seen in FIG. 1, the Golovatai reference includes a cylindrical armature (8) having a distal end that is tapered inwardly. Appellants submit that tapering the end of the armature (8) does not make the armature (8) shaped like the frustum of a cone.

Moreover, as best seen in FIGS. 1 and 2 of the Golovatai reference, the tapered end of the armature (8) is only adjacent to <u>one</u> of the polepieces (19) during the operation of the solenoid, not a substantial portion of <u>both</u> polepieces (19, 20) as required by claim 3.

By providing a frusto-conical armature that is adjacent to a substantial portion of the first and second polepieces, numerous advantages are realized. For example, using a frusto-conical armature provides an absolute minimum thickness of air gap while positively precluding the armature from striking the polepieces. *See Specification*, pg. 5, lines 15-20.

For at least the forgoing reasons, Appellants respectfully request that the rejection of claim 3 be withdrawn. As claim 4 depends from claim 3, this claim is also not taught or suggested by the references of record for the same reasons set forth with respect to claim 3. Thus, Appellants request that the rejection of claim 4 also be withdrawn.

**Issue 2 – Whether claim 5 is unpatentable under 35 U.S.C. § 103(a) by U.S. Patent No. 6,313,726 to Golovatai et al.**

Claim 5 depends from claim 3 and states that the respective diameters of the bearing bore and the shaft are as nearly identical as possible without endangering drag on the shaft.

Claim 5 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over the Golovatai reference. As stated above, the Golovatai reference does not teach or suggest a solenoid having an armature that is frusto-conical, wherein the frusto-conical section is adjacent to a substantial portion of the first and second polepieces as recited in amended claim 3. As claim 5 depends from claim 3 and includes all of the limitations therein, claim 5 is not taught or suggested by the references of record for at least the same reasons set forth with respect to claim 3. Thus, Appellants request that the rejection of claim 5 be withdrawn.

**Issue 3 – Whether claims 6, 7 and 10-16 are unpatentable under 35 U.S.C. § 103(a) by U.S. Patent No. 6,313,726 to Golovatai et al. in view of U.S. Patent No. 5,947,092 to Hussy et al.**

As with claim 3, claims 6, 7 and 10 include a solenoid actuator or solenoid having an armature that is frusto-conical, wherein the frusto-conical section is adjacent to a substantial portion of the first and second polepieces. Therefore, Appellants submit that claims 6, 7 and 10 are also not taught or suggested by the Golovatai reference for at least the same reasons set forth with respect to claim 3.

The Hussey reference fails to add anything to the Golovatai reference except to provide a space-efficient electromagnetic actuated exhaust gas recirculation valve for an engine. As in the Golovatai reference, the armature (110) used in the Hussey reference is cylindrical, not frusto-conical. Furthermore, the sleeve (112) used in the Hussey reference contributes to the thickness of the non-magnetic gap between the armature and the polepieces thereby limiting the maximum actuating force of the solenoid. *See Specification*, pg. 2, lines 8-13; FIG. 1. Therefore, the Hussey reference actually highlights the drawbacks and deficiencies of the prior art that the present invention intends to solve.

For at least the above reasons, Appellants request that the rejection of claims 6, 7 and 10 be withdrawn. Since claims 11, 12, 14, 15 and 16 depend from claims 6, 7 and 10, these claims are also allowable over the Golovatai and Hussey references for at least the same reasons discussed above with respect to claim 3.

Claim 13 is directed to a solenoid for providing linear actuation. The solenoid includes first and second polepieces having axial bores coaxially disposed along a common axis, an electrical conductor wound about the polepieces in a plurality of turns, an armature, a bearing and a shaft. The armature is movably disposed in the axial bores. The bearing is axially retained in one of the first and second polepieces. The shaft is attached coaxially to the armature and extends through a supportive bore in the bearing, wherein the bearing radially supports the shaft. The shaft is axially displaceable by electromagnetic displacement of the armature to provide the actuation. The armature is entirely separated from the axial bores of the polepieces by a generally cylindrical air gap, wherein the bearing has an axial length that is at least 1.5 times larger than the diameter of the shaft.

None of the references of record teach or suggest a solenoid including a bearing and shaft, wherein the bearing has an axial length that is at least 1.5 times larger than the diameter of the shaft as recited in claim 13. In order to establish a prima facie case of obviousness, the Examiner must provide specific reasons for the determination that the claimed subject matter is suggested by the references of record. *See Ex parte Humpherys*, 24 USPQ.2d 1255 (B.P.A.I. 1992).

In rejecting claim 13, the examiner stated that "the ratio of the bearing (sic) length to the shaft diameter is considered to be an optimum range decision. *See Final Office Action*, pg. 3, ¶ 4. However, the Examiner has failed to point out any specific features or discussion in the Golovatai and Hussey references that

disclose or suggest a bearing having an axial length that is 1.5 times larger than the diameter of the shaft.

Even if an explanation of the rejection of claim 13 was provided by the Examiner, Appellants submit that the combination of the Golovatai and Hussey references fail to suggest a bearing having an axial length that is at least 1.5 times larger than the diameter of a shaft. In the Final Office Action, the linear ball cage (12) in the Golovatai reference was used to teach the bearing set forth in claim 13. *See Final Office Action*, ¶¶ 2, 5. However, as best seen in FIG. 2 of the Golovatai reference, the ball set (18) functions as the bearing between the polepiece (19) and the shaft (10), not the linear ball cage (12). The linear ball cage (12) merely operates to hold the ball set (18) in position. As such, in evaluating claim 13, the axial length of the ball set (18) in the Golovatai reference should be compared with the diameter of the shaft (10). A review of FIG. 2 shows that the axial length of the ball set (18) is not 1.5 times greater than the diameter of the shaft (10).

Providing a solenoid having a bearing with an axial length that is at least 1.5 times larger than the diameter of a solenoid shaft minimizes the wobble of the shaft in the bearing and cocking of the armature within the polepieces. *See Specification*, pg. 5, lines 13-15. The use of the bearing that is at least 1.5 times larger than the diameter of a solenoid shaft eliminates the need to use ball bearings that engage duel shafts (10) that extend from opposite sides of the armature (8) to keep the armature in alignment. *See Golovatai*, FIGS. 1 and 2. This feature in the present invention also eliminates the need to place ball

bearings in contact with the armature (8) as best seen in FIGS. 5-9 of the Golovatai reference. Thus, a prima facie case of obviousness has not been established, and Appellants request that the rejection of claim 13 be withdrawn.

Dependant claims 14-16 also include a limitation directed to a bearing that has an axial length that is at least 1.5 times larger than the diameter of the shaft. For the same reasons set forth above with respect to claim 13, Appellants submit that claims 14-16 are further distinguishable over the references of record.

For each ground of rejection which Appellants contest herein applies to more than one claim, such additional claims, to the extent separately identified and argued above, do not stand or fall together.

For at least the foregoing reasons, Appellants submit that the references of record fail to teach or suggest every limitation disclosed in claims 3-7 and 10-16 and request that the rejection of these claims be withdrawn.

Respectfully submitted,

Dated: 11/10/04

Dennis B. Danella
Reg. No. 46,653

**JAECKLE FLEISCHMANN & MUGEL, L.L.P.**
190 Linden Oaks
Rochester, New York 14625-2812
Tel: (585) 899.2930
Fax: (585) 899-2931

## VIII. CLAIMS APPENDIX

The text of the claims involved in the appeal reads as follows:

3. A solenoid for providing linear actuation, comprising:

a) first and second polepieces having axial bores coaxially disposed along a common axis;

b) an electrical conductor wound about said polepieces in a plurality of turns;

c) an armature movably disposed in said axial bores, wherein said armature is frusto-conical, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces;

d) a bearing axially retained in one of said first and second polepieces; and

e) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

4. A solenoid in accordance with Claim 3 wherein said solenoid is included in an actuator attachable to a device for providing linear actuation to said device.

5. A solenoid in accordance with Claim 3 wherein the respective diameters of said bearing bore and said shaft are as nearly identical as is possible without engendering drag on said shaft.

6. A valve assembly for exhaust gas recirculation between the exhaust manifold and the intake manifold of an internal combustion engine, said assembly including an exhaust gas recirculation valve and further including a solenoid actuator attached to said valve, said solenoid actuator having first and second polepieces having axial bores coaxially disposed along a common axis, an electrical conductor wound about said polepieces in a plurality of turns, a frusto-conical armature movably disposed in said axial bores, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces, a bearing axially retained in one of said first and second polepieces, and a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide actuation of said valve, wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

7. An internal combustion engine, comprising:

a) an intake manifold;

b) an exhaust manifold; and

c) a valve assembly for exhaust gas recirculation between said exhaust manifold and said intake manifold, said assembly including an exhaust gas recirculation valve and further including a solenoid actuator attached to said valve and having first and second polepieces having axial bores coaxially disposed along a common axis, an electrical conductor wound about said polepieces in a plurality of turns, a frusto-conical armature movably disposed in said axial bores, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces, a bearing axially retained in one of said first and second polepieces, and a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide actuation of said valve to admit exhaust gas from said exhaust manifold into said intake manifold, wherein said armature is entirely separated from said axial bore of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

10. A solenoid for providing linear actuation, comprising:

a) a housing;

b) first and second polepieces, within said housing, having axial bores coaxially disposed along a common axis;

c) an electrical conductor wound about said polepieces in a plurality of turns;

d) an armature movably disposed in said axial bores, wherein said armature is frusto-conical, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces;

e) a bearing axially retained in one of said first and second polepieces; and

f) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bore of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

11. A solenoid in accordance with Claim 10 wherein said solenoid is included in an actuator attachable to a device for providing linear actuation to said device.

12. A solenoid in accordance with Claim 10 wherein the respective diameters of said bearing bore and said shaft are as nearly identical as is possible without engendering drag on said shaft.

13. A solenoid for providing linear actuation, comprising:

a) first and second polepieces having axial bores coaxially disposed along a common axis;

b) an electrical conductor wound about said polepieces in a plurality of turns;

c) an armature movably disposed in said axial bores;

d) a bearing axially retained in one of said first and second polepieces; and

e) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

14. A solenoid in accordance with Claim 6 wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

15. A solenoid in accordance with Claim 7 wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

16. A solenoid in accordance with Claim 10 wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

## IX. EVIDENCE APPENDIX

There has been no additional evidence submitted, entered by the Examiner, or relied upon by the Appellant in the present appeal.

## X. RELATED PROCEEDINGS APPENDIX

There have been no proceedings or decisions rendered by a court or the Board that relate to the present patent application.